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Promotion of Indian mustard (*Brassica juncea*) through front line demonstrations in irrigated agro-ecosystem: A case study

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Abstract

CCS HAU Krishi Vigyan Kendra, Panipat, Haryana, conducted this study in farmers' fields under irrigated farming conditions from 2019-20 to 2021-22 employing participatory interventions under Cluster Frontline Demonstration (CFLD). The study's main goal was to determine the yield gap between Improved Practice (IP) and farmer's practice (FP). During this time, a total of 350 CFLDs were done on 140 hectares of rice wheat and alternate cropping system, covering 19 villages and 350 farmers. Farmers meetings and focused group conversations with farmers were used to identify the gaps. Improved varieties (RH 749 & RH 725), seed treatment with carbendazim @ 2 g/Kg seed, and seed inoculation with PSB and Azotobacter were among the major technological interventions tested under CFLDs. Major technological interventions demonstrated under CFLDs consisted of improved varieties (RH 749 & RH 725), seed treatment with carbendazim @ 2g/Kg seed, Bio-fertilizer inoculation of seed with PSB & Azotobacter @ 125 ml/ha, Pre-emergence application of pendimethalin @ 2.5 ltr/ha for weed management, recommended doses of fertilisers (NPK @80:30:20 Kg/ha, and Zinc Sulphate @ 25 Kg/ha and need based plant protection measures. According to data collected over three years, the superior practise raised output by up to 11.1% above the farmer's previous practices of 19.0 q/ha, averaging 20.7 q/ha. The extension gap, technology gap, and technology index calculated averages were 1.2 q/ha, 7.2 q/ha, and 25.9 q/ha, respectively. As a result, it can be stated that mustard crop productivity can be raised by cultivating improved varieties and using a whole package of mustard crop practices.

Keywords: Technology gap, extension gap, Indian mustard

Introduction

Oilseed crops are India's second largest agricultural commodity after cereal crops, accounting for around 13.0 percent of gross cultivated area and 11.0 percent of total agricultural output value. This crop is a significant source of income for small and marginal farmers, particularly in rainfed areas of the country (Sangwan *et al*. 2021) [1]. Due to a big initiative taken by the Government of India and excellent climatic circumstances, the country produced the maximum output of 365.65 lakh tonnes oilseeds grains during 2020-21, with a productivity level of 1269 kg/ha from an area of 288.18 lakh ha (Anon, 2020-21) [2]. Rapeseed and mustard contributed roughly one-third of the country's edible oil among the nine primary oilseed crops (Langadi *et al*., 2021) [3]. In India's rabi season, the two main oilseed crops are rapeseed and mustard, both of which are crucial to the country's food and nutritional security. India mustard is a significant oilseed crop, accounting for more than 80% of the country's total production of rapeseed-mustard (Meena *et al*., 2014; Meena *et al*., 2015) [4, 5]. The largest production of rapeseed and mustard was also reported in India, with 91.23 lakh tonnes produced from 68.56 lakh ha, and the average productivity was 1331 kg/ha (Anon, 2019-20) [6]. Rajasthan (44.9%), Haryana (12.4%), Madhya Pradesh (11.3%), Uttar Pradesh (10.60%) and West Bengal (7.53%) are the top rapeseed-mustard producing states in India. Gujrat has the highest yield (1932 kg/ha) among the major oilseed producing states in India, followed by Haryana (1793 kg/ha), Madhya Pradesh (1538 kg/ha), Rajasthan (1366 kg/ha), and Tamil Nadu (233 kg/ha) (Anon., 2022) [7]. Krishi Vigyan Kendra is a district-level organization that assesses, refines, and disseminates proven technologies in various micro farming situations throughout the district. Frontline demonstrations (FLD) are long-term demonstrations organized by scientists in a systematic way on farmers' fields to demonstrate the productivity potential and profitability of improved technologies and management practices in actual farm circumstances. Mustard CFLDs were held in 2019-20, 2020-21 and 2021-22. The primary goal of these demonstrations in general is to increase productivity through the dissemination of farm technology.

The current study was carried out to access the impact of these demonstrations on mustard production technology in order to increase the yield and fulfill the goal of providing higher returns and nutritious feed to farmers.

Materials and Methods

This study was conducted in farmers' fields in Panipat (Haryana) under irrigated farming conditions from 2019 to 2022 using CFLD as a farmer participatory intervention. The most prevalent cropping sequence in the district is the rice-wheat cropping system (RWCS). The district's net sown area is 96000 ha and the area under RWCS varies from 75000-80000 ha in different years of study. The district's minor crop is oilseeds. The soil texture of the demonstrated fields was sandy loam to loam, poor in organic carbon, low to medium in phosphorus and high in potassium. In total, 350 demonstrations were held on 140 acres of land, involving 19 villages and 350 farmers. The farmers were selected randomly from the villages in each year and the area under each demonstration was 0.40 ha (1.0 Acre). The gap analysis was done in operational villages during 2019 and 2022 by comparing the farmers' practice of cultivating mustard with the recommended production technology as to assess the gaps and impact. All assistance, including training, crucial inputs, and technical support, was provided to the selected farmers in the system mode using appropriate and need-based interventions in the prior and succeeding mustard crops. Field visits were carried out to monitor the demonstrations on a regular basis, and field days were organized with the participation of both adopters and non-adopters. In the local check, farmers followed their own cultivation practices, whereas demonstration plots followed the recommended production package. Data on various technical and economic parameters such as cost of production, yield, and market price were collected and analyzed in the context of typical indices for such case studies. The yield of 26 q/ha was applied as potential yield of mustard varieties RH 725 & RH749 for this study. The extension gap, technology gap and technology index were calculated as per the formula given by Samui *et al*. (2000) [8]:-

a) Extension gap (EG) = Demonstration yield-local check yield
b) Technology gap (TG) = Potential yield-Demonstration yield
c) Technology index (TI) = {(Potential yield-Demonstration yield)/Potential yield} x 100

Results and Discussion

The improved varieties were selected for cluster Front Line Demonstrations because they have several unique characteristics, such as a low incidence of diseases such as white rust, sclerotinia stem rot, downy mildew, and powdery mildew. These varieties have total crop duration of 145-148 days and are tolerant to lodging and shattering. These varieties had high oil content of up to 39-40% and high average yields of 24-28 q/ha.

Table 1: Yield and Technological gap analysis of CFLD on Indian mustard at Farmer's field

Year	No. of CFLD	Area (ha)	DP (q/ha)	FP (q/ha)	% increase in yield over FP	Extension gap (q/ha)	Technological gap (q/ha)	Technology Index (%)
2019-20	100	40	20.0	18.7	6.9	1.3	8.0	28.5
2020-21	125	50	22.2	19.6	13.2	2.6	5.8	20.7
2021-22	125	50	20.0	18.7	13.2	1.3	8.0	28.5
Mean	350	140	20.7	19	11.1	1.7	7.2	25.9

DP-Demonstration Plot FP-Farmers' Practices

Grain Yield

The yields obtained in three successive years under CFLDs and farmers practices are presented in Table 1. The data revealed that a total of 350 demonstrations were carried out over an area of 140 ha. In different years, the variety RH 0749 and RH 725 performed and yielded more than the local check. The average yield of three consecutive years revealed greater grain recovery i.e. 20.7 q/ha in demonstration plots against 19.0 q/ha in farmers' practice plot. The grain yield of mustard increased from 6.9 percent (2019-20) to 13.2 percent (2021-22). The results of demonstrations plots motivated the farmers and they were agreed to take on the technology in future. These results clearly show that proper weed management is possible due to knowledge and the adoption of appropriate technology, such as better varieties (RH 0749& RH 725), seed treatment with fungicide and bio fertilizers, the use of a balanced dose of fertilizer, and the use of a balanced dose of fertilizer. The findings are consistent with those of Kumar *et al*. 2017) [9].

Extension Yield Gap Analysis

The extension gap is the difference between demonstration yield and farmers' practice yield and average extension gap and it was recorded 1.7 q/ha. The highest extension gap of 2.6 q/ha was reported in 2020-21, followed by 1.3q/ha in 2019-20 and 2021-22 (Table 1). Higher the extension gap explained the lack of awareness for adoption of improved Indian mustard cultivation practices by the farmers. Hence, it is suggested that efforts are required to make aware and encourage farmers to adopt improved cultivation practices over existing conventional practices. Singh *et al*. 2021) [10] observed average extension gap of 1.8q/ha and emphasized need to educate farmers for adoption of improved practices of summer moong cultivation.

Technology Yield Gap and Technology Index

Technology gap is defined as the difference between demonstration yield and potential yield and average technological gap of three successive years was recorded 7.2 q/ha, which was lowest (5.8 q/ha) in 2020-21 and largest (8.0 q/ha) in 2019-20 and 2021-22 (Tables 1). The gap may be due to variation in soil fertility, weather condition at maturity of Indian mustard, integrated crop management practices etc. Similarly, the technology index for all demonstrations over the years was in accordance with the technological gap. Higher technology indexes indicated inadequacy of technology and/or insufficient extension services for technology transfer. The data presented in Table 1revealed that technology index varied from 20.5 to 28.5 percent. Kumar *et al*. (2019) [11] reported as high as 55.0 to 70.8

percent technology index in their study. Technology index can be minimized with appropriate adoption of demonstrated technical interventions to increase the yield performance of mustard crop. Similar findings are reported by Kumar, S. and Jakhar, D.S. (2022) [12].

Economic analysis of CFLDs on Indian mustard

Economic returns have been shown to be a function of grain yield and the Minimum Support Price (MSP) or sale price, which fluctuated throughout the year. Different variables like seed of improved varieties, bio-fertilizers, herbicides and pesticides were considered as cash inputs for the FLD demonstrations as well as for farmers practice. The results reported in Table 2 illustrates about the additional return of demonstrated plots were ranged from Rs. 6440 to Rs. 14284 per ha during different years in comparison with farmers practices. The most significant average net return of Rs. 93395 was reported in 2021-22. This may be attributed to the use of improved technologies in demonstration plots. The average gross return of Rs. 95109/ha, Rs. 120557/ha and Rs. 120694/ha were recorded in the year 2019-20, 2020-21 and 2021-22 respectively. The average net return for respective years to the tune of Rs. 67647/ha, Rs. 91199/ha and Rs. 93395/ha during the three consecutive years of study. Similar conclusions were confirmed by Singh *et al*., (2019) [13] in oilseeds, Meshram *et al*., (2022) [14] reported the highest average net income of Rs. 51549-00 with the B: C ratio of 2.73 to 3.06 during their study period.

Table 2: Economic analysis of CFLDs and farmers' practice of Indian mustard

Year	Average cost of cultivation (Rs./ha)		Average gross return (Rs./ha)		Average net return (Rs./ha)		Additional return	B:C Ratio	
	DP	FP	DP	FP	DP	FP	(Rs/ha)	DP	FP
2019-20	27462	28356	95109	89590	67647	61234	6440	3.4	3.1
2020-21	29358	30381	120557	107296	91199	76915	14284	4.1	3.5
2021-22	27299	26008	120694	105577	93395	79569	13826	4.4	4.0
Mean	28039.7	28248.3	112120	100821	84080	72572.7	11516.7	4.0	3.5

Table 3: Technological gap analysis for Indian mustard

Technology	Recommended Practice	Farmers' Practice	% age Gap
Variety	RH 749 &RH 725	Local/private company seeds	65
Seed Rate	5 Kg/ha	7.5 Kg/ha	85
Seed Treatment	Carbendazim@2g/Kg seed	No Treatment	100
Biofertilizer inoculation of seed	Biofertilizer inoculation of seed with PSB & Azatobacter @ 125 ml/ha	No Biofertilizer inoculation of seed	100
Fertilizers use (Kg/ha)			
N	80	No application	100
P	30	20 Kg/ha	80-85
K	20	No application	100
Zn	10	No application	100
Weed Management	Pre-emergence application of pendimethalin @ 2.5 ltr/ha	65 percent farmers use recommended practice	35
Disease Management	600g mancozeb in 200-300 litres of water per Acre	60 percent farmers use recommended practice	45
Pest Management	Spray of dimethoate 30 EC @ 1.0 Litre $ha^{-1}$for aphid management	55 percent farmers use recommended practice	45

The results in Table 3 showed that farmers had a 100% gap in seed treatment with carbendazim and bio fertilizer inoculation of seed with PSB & Azotobacter. The difference between improved varieties and seed rate was 65 percent and 85 percent, respectively. In the case of weed and insect pest and disease management, only 65 percent and 55 percent of farmers applied suggested practices, respectively. As a result, there was an urgent need to close the gap through raising awareness among farmers, which may ultimately lead to an increase in yield and returns.

Major Extension activity under CFLDs on Indian mustard

Capacity building and technological support using appropriate and need-based extension activities are crucial for supplementing and complementing demonstration output for wider outcomes and generating feedback for researchable topics and policy actions. During the study period, 11 trainings and 10 field days were held for all farmers participating in demonstrations and other stakeholders. During the study period, scientists visited farmers' fields on 23 occasions to monitor CFLDs plots, and 32 agro-advisories were issued on necessary remedies. The extensive method of demonstration coupled with extension activity generated desirable output and outcomes by closing gaps in production technology, enhancing yields and returns, and boosting Indian mustard cultivation even in alternative settings. Meena and Singh (2017) [15] noted similar findings.

Table 4: Extension activities conducted under CFLD on Indian mustard

Year	Trainings		Field Days		Field Visits		Agro-advisories
	Number	Participants	Number	Participants	Number	Participants	Number
2019-20	3	90	3	190	9	92	8
2020-21	3	104	3	153	8	59	12
2021-22	5	340	4	123	6	67	12
Total	11	534	10	466	23	218	32

Conclusion

On the basis of three successive years of CFLDs, it may be concluded that economic return and productivity of Indian mustard crop could be enhanced with scientific production technologies. Specific technologies, such as improved variety and recommended seed rate, seed treatment with thiram, seed inoculation with bio-fertilizer, pre-emergence application of herbicides for weed control, proper dose of fertilizer and micronutrients, and plant protection measures, were selected cautiously. According to the results of this study, CFLD programmes were very efficient in promoting and influencing the attitudes of other farmers towards improved cultivation and crop management practices. Hence, it is urged that technology be popularized in order to reduce extension gaps, technology gaps, technology index gaps and there by yield gap so as to increase the income of farmers and.

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